

**The Ultimate Summit for Science**

**NASA**

# Olympus: Defining a New Era in Scientific Ballooning

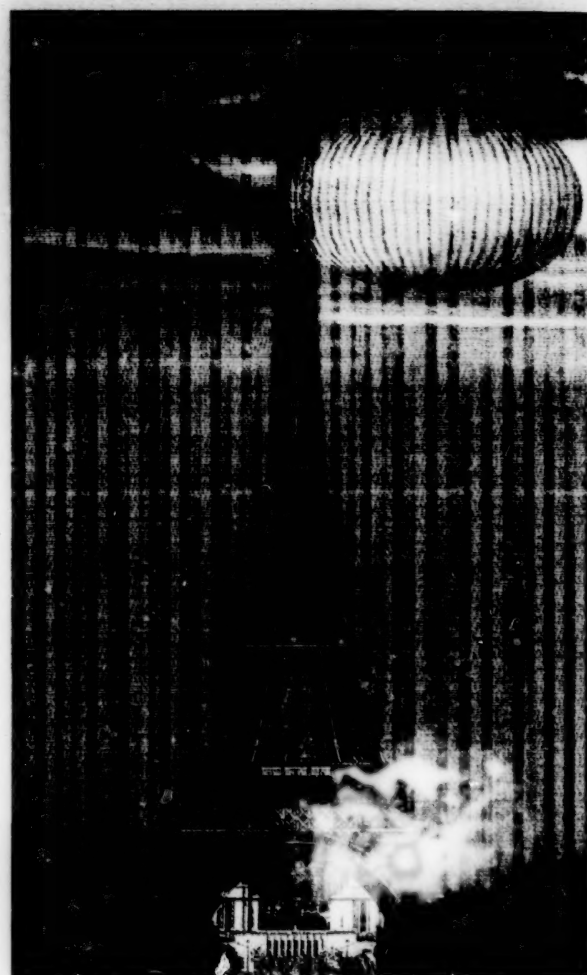
**H**igh above the world-class observatories that dot Hawaii's dormant Mauna Kea volcano, floating farther yet over the hostile and nearly inaccessible peaks of Mt. Everest, lies a summit waiting to be conquered. Here — above the clouds and city lights and over 99.7% of the atmosphere — is a platform on the edge of space, home to a broad range of astronomy and physics experiments.

Today, balloons are lifting experiments longer, higher and more inexpensively than ever before, and returning them safely to Earth for reuse. Week-long flights at altitudes of approximately 35 kilometers carrying payloads in excess of several tons are the norm. NASA now plans to extend this platform and create a new generation of balloons capable of staying afloat with such cargo for 100 days and ultimately 1,000 days.

What do some scientists hope to accomplish with 100 or even 1,000 days at the edge of space? To name but a few proposals on the table: Jupiter-size planet searches, large-aperture solar astronomy, large-aperture infrared astronomy, cosmic-ray investigations, long-duration Earth science missions, and hard x-ray imaging experiments.

Olympus defines a new era in scientific ballooning. Advances in material science and trajectory control are enabling revolutionary capabilities. Very large scientific payloads can now be reliably launched and retrieved for reflight at a range of altitudes. Balloon flight still remains a fraction of the cost of a rocket launch.

The ultra long duration balloon, with its 100-day maiden flight planned for 2001, provides a long-term facility in a near-space environment for many types of science. This is a stratospheric mountaintop well worth the climb.



Relative Size of  
Olympus-Class Balloons



Breitling Orbiter 3  
(First Manned, Non-stop  
Global Flight, 1999)



747

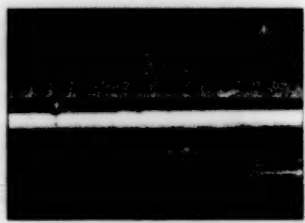
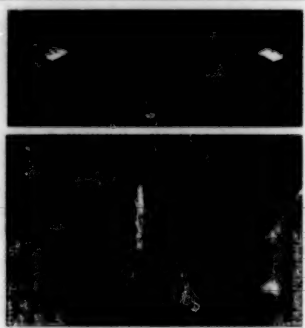



Olympus

# Olympus Is

**O**lympus is the launch vehicle resulting from a NASA planning and requirements study defining the future of long-duration ballooning. It will enable a broad range of missions from NASA's Earth- and Space Science Enterprises to expand humankind's knowledge. Through the use of emerging and innovative technology Olympus will leapfrog over current balloon program capabilities.

Technology for Olympus will not be developed in a vacuum — technologies will be acquired from developments elsewhere within NASA, other government agencies, and industry. Critical technologies that will enable Olympus to be a reliable, world-class platform have been identified.

| Challenge   |   | * Goals  |
|---|---|--|
| Balloon Envelope Design and Manufacture   |   |  |
| Design and Analysis Tools   |   | * Advanced Dynamic Modeling Software   |
| Material Development <ul style="list-style-type: none"><li>• Robust Material Weight</li><li>• Nondegrading at Operational Altitude</li></ul>                            |   | * 1,000-Day Flights at > 40 km Altitude with Payloads >2500 kg   |
| Quality Control <ul style="list-style-type: none"><li>• Automated Seaming</li><li>• Automated Inspection</li></ul>  |   | * Automated Manufacturing<br>* Automated Inspection  |
| Recovery Systems  |   |  |
| Aerodynamic Deceleration Systems <ul style="list-style-type: none"><li>• Land Payload in Targeted Area</li></ul>  |  | Target Area<br>* 100 Meter Radius  |
| Locator Systems <ul style="list-style-type: none"><li>• Extreme Environment Beacon</li><li>• GPS Location "Phone Home" System</li><li>* Contamination Control</li></ul> |   | Drop point<br>80 Kms<br><br>* Extreme Environment Beacon<br>* GPS "Phone Home" System with 1-year Life<br>* Protective Enclosure |
| Trajectory Control  |   |  |
| Stratospheric Weather Forecasting<br><br>Trajectory and Altitude Control  |  | * Accurate Long-term Stratospheric Wind Predictions<br>* Trajectory Control System & Trajectory Simulations                      |
| Pointing  |   |  |
| Arcsecond Pointing  |   | * Gondola Pointing Control System  |

## Olympus-Enabled Science

**S**cientists have at their disposal a variety of ground, near-space, and space-borne telescopes and instruments operating at a wide range of wavelengths. Olympus will allow scientists the opportunity to conduct long-term observations in the near-space environment of the stratosphere.

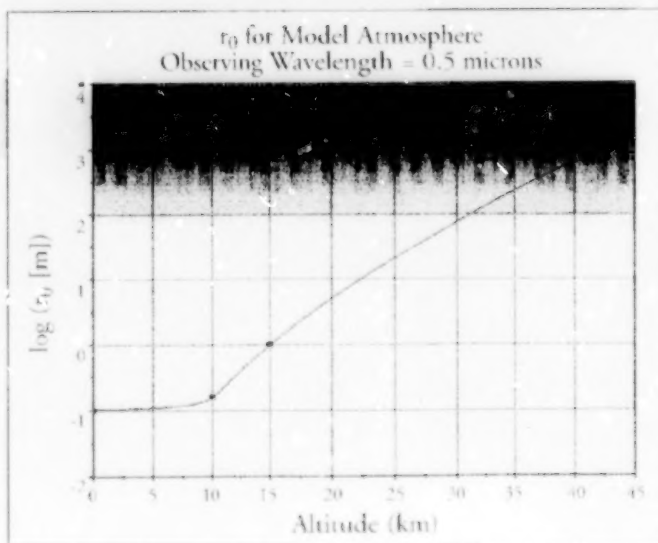
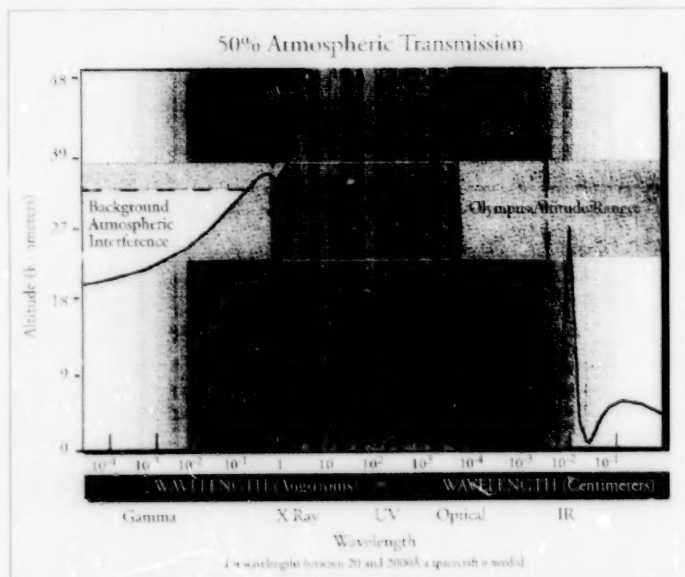
With the exception of visible light and radio waves, the Earth's atmosphere is largely opaque to most wavelengths in the electromagnetic spectrum. However, Olympus will reach altitudes above 99.7% of the atmosphere, where x rays and gamma rays are plentiful. With the advent of Olympus, very large and massive floating observatories that are needed to improve the quality and accuracy of scientific findings will be possible. The advantage of size is especially important for high-energy particle detection because they are relatively sparse, and large instruments are needed to collect significant numbers of particles in a reasonable time.

## Data Collection Efficiency

**P**olar flights provide nearly continuous viewing in day or night conditions for several months at a time (24-hour day/night cycle on target). Lower latitude flights have a 12-hour day/night cycle (12-hour day/night cycle on target). Compare these to low-Earth orbit satellites that have  $\leq 66$  minutes of on-target time out of every 90 minutes due to Earth occultation.

## Seeing

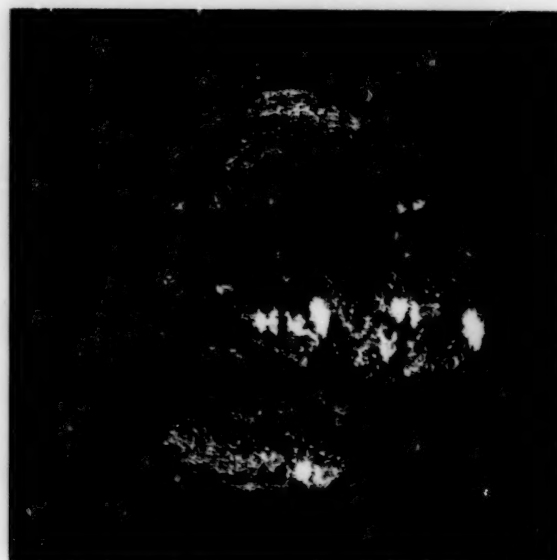
**O**lympus will fly above the jet stream, avoiding micro-physical atmospheric processes — such as variations in atmospheric refractive index caused by turbulence from bulk topological and convective shear winds in the troposphere — that obscure viewing. The Fried parameter ( $r_0$ ), the distance over which the phase in the wavefront changes by  $4/5$  radians, is a commonly used measure of the total image degradation due to atmospheric turbulence.



## Potential Applications

**D**uring Coronal Mass Ejections (CME's), molten materials from the upper atmosphere of the Sun are propelled through the solar system impacting communication, power transmission, and weather on Earth. Some of the energetic particles from CME's cross the gulf between the Sun and Earth in just 30 minutes. Long-duration balloons can monitor the Sun's changing environment.

*Large-Aperture  
Solar Astronomy*



11/02/00

12/17/00

1/29/01



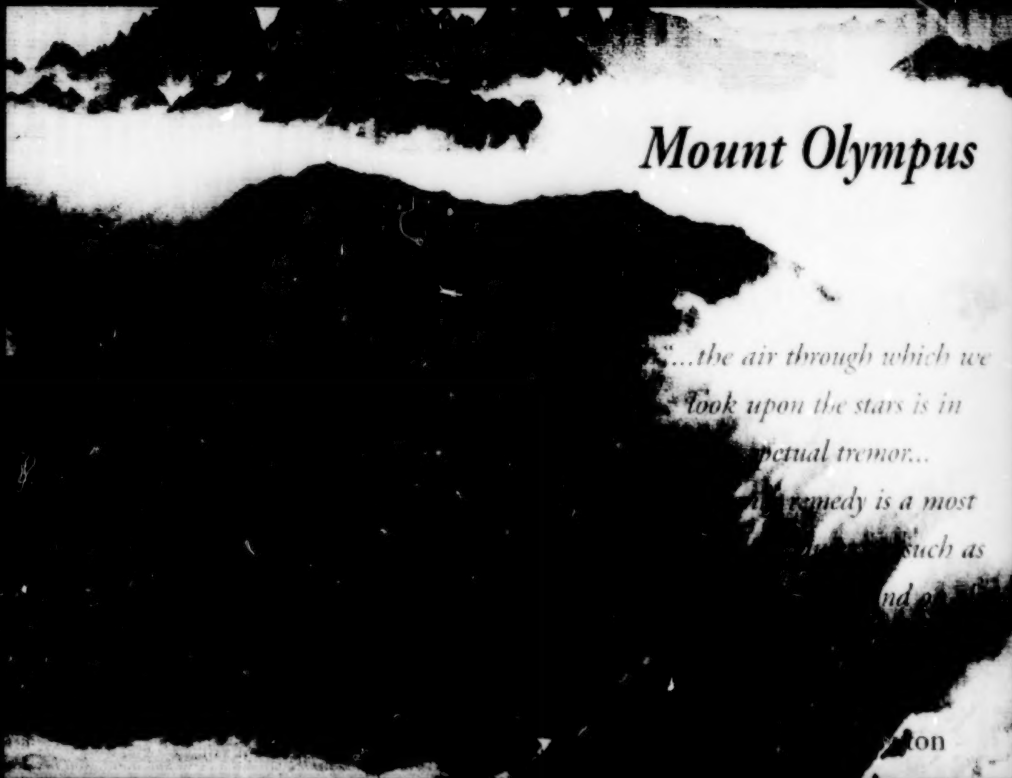
*Iceberg Tracking*

The Earth's ice cover is melting at higher rates and in more places than at any time since record keeping began. The effects of global warming can be tracked by monitoring changes in the surface heights of ice sheets and their dynamics.

High-resolution images of planets and their moons are not limited to the Hubble Space Telescope. Balloons can capture similar images using large-aperture telescopes.

*Hubble Space  
Telescope  
Resolution of  
Planets and  
Moons*





## *Contacts & Information*

Balloon Program Scientist  
Dr. Jack Tueller  
301-286-4678  
tueller@gsfc.nasa.gov

Ultra Long Duration Balloon  
L. Steve Smith  
301-824-1069  
l.s.smith@gsfc.nasa.gov

Olympus  
Robin Mauk  
301-286-5841  
robin.mauk@gsfc.nasa.gov

Balloon Program: [www.wff.nasa.gov/pages/scientific/balloons.html](http://www.wff.nasa.gov/pages/scientific/balloons.html)

UDB Project: [www.wff.nasa.gov/uldb/](http://www.wff.nasa.gov/uldb/)

Olympus: [http://heawww.gsfc.nasa.gov/docs/balloon/UDB\\_study/UTRA.html](http://heawww.gsfc.nasa.gov/docs/balloon/UDB_study/UTRA.html)

## *Acknowledgements*

C. Wanjek, J. Barzak, U. Bruegman, D. Dawkins, and D. Kelly



**END**